Innovative Teaching Methods for Active Learning

Guided Inquiry Learning
The POGIL Project

- Process Oriented, Guided Inquiry Learning
- Developed in college Chemistry classrooms (1994), has since expanded to other fields and into high school level
  - Analytical chemistry, anatomy and physiology, biology, biochemistry, computer science, engineering, math, physical chemistry, etc
  - Supported through NSF grants
- Active learning is structured within POGIL activities that the students work through
Process Oriented

• Process skills are a part of the complete POGIL package
• Active learning activities are done in groups
• Students are assigned roles within the group: Manager, recorder, presenter/spokesperson, reflector/analyst
• Teams are self-managed; instructor is a facilitator
• Process skills are imbedded in the activities, not necessarily dependent on the facilitation
Guided Inquiry Learning

• An exploration of the relevant content
• Emphasis on the Learning Cycle
  – Exploration
  – Concept invention/Term introduction
  – Application
• Structured around a Model
  – Guided exploration of the model by questions aimed at developing a concept
  – Application of this concept to advanced question
  – Also can deepen, refine or integrate previous material and/or concepts
The Model

• The students are expected to explore or study the model
• Could be data, equations, diagrams, text, graphics, processes, hands-on activities
• Expected to articulate and record explanations
• Activities are structured toward a central idea
• How many protons/neutrons/electrons found in $^{12}$C? $^{13}$C? $^{13}$C$^-$?

• With your group decide what feature distinguishes a neutral atom from an ion.

• What do you think all carbon/hydrogen atoms and ions have in common?

• How many protons, neutrons and electrons are there in one atom of $^1$H$^+$?

• What do all nickel (Ni) atoms have in common?

$^{1}$H and $^2$H are isotopes of hydrogen. $^{12}$C and $^{13}$C are isotopes of carbon.
Phase change investigation

- Model is illustrations of a mass of water in a piston:
Phase change investigation

- Students calculate specific volume for each state point and plot temperature vs. volume.
- Vapor quality is introduced in questions.

T-v diagram for this process
Carnot cycle investigation

- Incomplete computer model of a Carnot cycle is provided, with diagram window that takes inputs and outputs
- Students complete the computer model and questions require progressive understanding
Scientific method

• Lots of times we teach science without using the scientific method
• Use of Guided Inquiry and the Learning Cycle more closely mimics the scientific method in the classroom